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Field Windbreaks Temper Effects of Drought

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The United States was not aware of the seriousness of soil loss through wind erosion until the first great dust storm on May 12, 1934, known as the Dust Bowl. The storm originated in western Kansas, Texas, Oklahoma, and eastern Colorado, and swept across the U.S. in a north and easterly direction for hundreds of miles over the Atlantic, carrying an estimated 200 million tons of soil, reaching heights of almost 2 miles.

Dust settled in Canada, blocked out the sun over our nation's capital, and sifted through windows and screens of homes and office buildings across the country. Some farms lost topsoil to plow depth. The blowing soil particles cut off crop plants at the soil line.

The catastrophic proportions of crop destruction and loss of the productive potential of farmland that followed the 1934 Dust Bowl had a pronounced effect nationwide. Farmers who witnessed the destruction of current crops and the overnight disappearance of fertile topsoil—the basic ingredient of future crops—knew that something had to be done at once to rebuild the land and prevent any future topsoil loss. The public, too, quickly realized that the farmers' crop loss was its loss—lost food products to the consumer. Individuals and organizations, with a common purpose, banded together to protect the nation's topsoil. Wide-scale tree plantings on the Great Plains began. These plantings were called shelterbelts or windbreaks. The early windbreaks were multi-row, often as many as 20 rows wide. Later research showed that single-row windbreaks were just as effective.

Some Farmers Tend to Forget Past Droughts and Dust Storms

Not long after the great Dust Bowl, subsequent rains replenished the soil moisture. Since the dust had settled, crops once more flourished. People became complacent—the lesson that should have been learned from the Dust Bowl was soon forgotten. This complacency and the pressure on farmers immediately after World War II to produce more food to feed the world resulted in breaking new land for crop production. To help the farmer produce more food, farm equipment manufacturers increased the size of farm equipment. Some farmers, in their desire for expanded cropland to accommodate the large farm equipment, began to look on field windbreaks as obstacles to the efficient operation of this machinery. These farmers removed their windbreaks—windbreaks that probably contributed to their favorable crop years. The importance of the windbreak seemed to be forgotten.

During the mid-1950s, while farming operations were expanding, the U.S. experienced a period of drought with accompanying dust storms reminiscent of the Dust Bowl. Farmers again realized the importance of their topsoil, and many renewed their interest in soil conservation practices, including field windbreaks. But, again, as periods of favorable weather conditions followed the drought, interest in protecting precious topsoil began to wane, and complacency set in. Then came the drought and dust storms of the mid-1970s, followed by another revitalized interest in soil conservation practices and windbreaks. But again subsequent favorable weather repeated this complacency in many farmers.

However, the droughts of the mid-1950s and mid-1970s did bring back memories in some older farmers of the 1934 Dust Bowl and younger farmers saw the effects on cropland of more recent periods of drought and dust storms. For these farmers, implementing conservation measures, including windbreaks, to keep the fertile topsoil in place and conserve soil moisture became their way of providing an inheritance for future generations. Unfortunately, too many farmers did not learn the lesson that nature tried to teach in recurring patterns of drought and dust storms. And now, once again in 1988 the U.S. is reminded of nature's cycles—a period of drought accompanied by early spring winds blowing fertile topsoil off unprotected cropland and into roadside ditches.

Soil and Water Conservation Practices Necessary to Fight Drought

Will these lessons ever be learned? Maybe the drought of 1988 will finally teach more farmers and the public that, as stewards of the land, land is passed on from generation to generation. Although little can be done to reduce the damage of the 1988 drought and dust storms, something can be done about the drought and dust storms of the future.

We can control the effects of wind by reducing its capability to pick up soil particles and cause them to become airborne clouds of dust. How do we do this? By practicing appropriate conservation measures such as no-till, minimum till, ridge planting, strip cropping, and contour farming. To this we must add the important preventive measure—learned after the Dust Bowl of 1934 and to some measure after the droughts of the mid-1950s and mid-1970s—to reduce the velocity of the wind by planting grass strips and/or single-row tree windbreaks before the wind can cause soil loss and moisture depletion.

Soil erosion in Marshall County

How Single-Row Tree Windbreaks Conserve Soil and Moisture

Well-designed, single-row field windbreaks conserve soil and water by intercepting and holding winter snowfalls; reducing or preventing topsoil loss by wind erosion; reducing evaporation and transpiration; reducing wind damage to crop leaves; and moderating soil and air temperatures.

A well-designed field windbreak will intercept snow and allow it to filter through the trees and spread uniformly over the protected cropland. On unprotected fields, snow (along with topsoil) will be swept off the fields and fill up roadside ditches. When uniform snow distribution melts, the result is a uniform recharge of soil moisture and a more uniform stand of crops. A winter snow cover could mean the difference between having a crop or not having a crop when the winter is followed by a period of drought such as that of 1988.

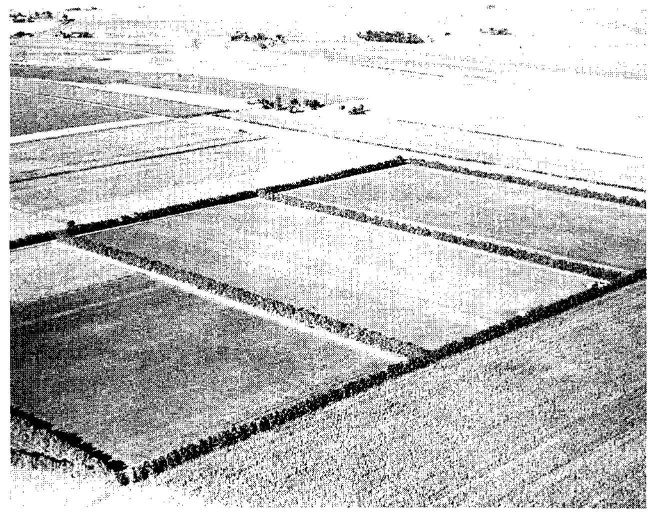
By reducing wind velocity, windbreaks will reduce or prevent the loss of fertile topsoil and in effect, conserve soil moisture. Topsoil contains organic matter that helps retain soil moisture. Blowing wind on unprotected fields will cause the fields to lose fertile topsoil and the blowing, drifting soil particles will cut off tender young crops by "sandblasting." Many farmers were forced to replant their crops two or three times in 1988 because of this "sandblasting."

Field windbreaks reduce wind speed which, in turn, reduces the rate of water evaporation and transpiration from crop plants. One study has shown that evaporation rates on the protected side of a field windbreak was 60 percent less at 5H (5 times the windbreak height), 40 percent less at 10H, and 20 percent less at 20H. The reduction of wind velocity over sheltered crops protected by a field windbreak means that less water vapor from evaporation and transpiration of crop leaves is moved out of the protected zone. This means the humidity in protected fields is higher than in open fields; protected crops use less water and use it more efficiently than unprotected crops. Hot, drying winds over open fields deprive crops of moisture by excessively increasing the rate of evaporation and transpiration, blowing the resulting water vapor away from the crops.

By reducing wind velocity, windbreaks reduce wind damage to crop leaves. The leaves on protected crops are considerably less subject to tearing and ripping. Undamaged leaves are healthier, remain turgid longer during times of drought, use moisture more efficiently, and make more efficient use of solar energy in the process of photosynthesis when carbohydrates are produced for use by the plants.

The moderating effect of windbreaks on both air and soil temperatures is beneficial to crops, especially during droughts. Air temperatures near the ground in protected crops are usually a few degrees cooler on hot days and a few degrees warmer on cool days and nights compared with temperatures in open fields.

Fairly uniform snow distribution on leeward (south) side of a hybrid poplar field windbreak



East-west, north-south orientation field windbreak cross hatch pattern

Windbreak Orientation Influences Windbreak Effects on Crops

Orientation of field windbreaks has an effect on crops by influencing snow distribution, shading, and soil erosion by wind. Most snow storms in Minnesota come from north of northwest. This means that an east-west oriented windbreak will do a better job of uniformly distributing snow on the leeward (south) side than a north-south oriented windbreak. Blowing, drifting snow approaches an east-west windbreak at a wider angle (more broadside), forcing more snow to filter through the windbreak and spreading it over the field. Blowing, drifting snow approaches a north-south oriented windbreak at a narrower angle, reducing filtering and causing deeper snowdrifts near the windbreak on the leeward side. Orienting a windbreak to produce the most uniform snow distribution possible is essential in preparing for future droughts.

During hotter daylight hours, crops on the north side of an east-west windbreak will receive more shade during mid-day and early afternoon, while crops on the east side of a north-south windbreak will receive more shade during late afternoon and early evening. This is of some benefit to crops during droughts.

Although winds from any direction can cause dust storms under the right conditions, most dust storms are caused by south or west winds. So to prevent dust storms, a network of both east-west and north-south oriented windbreaks is necessary. Most of the early spring dust storms in 1988 were caused by south winds; consequently, little soil moved behind east-west oriented windbreaks, while clouds of dust blew along both sides of north-south oriented windbreaks.

Effect of Field Windbreaks on Crop Yields

Many studies in the U.S., Russia, and other countries have shown that field windbreaks have the greatest effect on increasing crop yields in protected fields during dry seasons when moisture is a limiting factor. During extreme drought as experienced in 1988, crop yields in protected fields will not be great, but the harvest might pay for the seed, while in open fields it may not pay to harvest. Yields should be uniformly higher in protected fields where field windbreaks did a good job of uniformly distributing the previous winter's snowfall over the field. In fields where the design of the field windbreak resulted in major snowdrifts adjacent to the windbreak on the leeward side, yields

Taller corn on the leeward (south) side outlines previous winter's snowdrift pattern in Lyon County

should be higher in the snowdrift area except for a few crop rows or a narrow strip in the shade or root-zone area of the windbreak trees. In fact, in this situation, during the growing season, the taller, healthier crops will outline the previous winter's snowdrift pattern. Crop yields beyond this snowdrift pattern may be lower.

The effect of field windbreaks on increasing crop yields is not as dramatic during seasons when moisture is not a limiting factor. However, a windbreak that adequately performs its many functions contributes to higher crop yields, compared to crop yields in open, unprotected fields.

Managing Field Windbreaks during Periods of Drought

Managing field windbreaks during drought is no different from managing them during so-called normal seasons except that young plantings should be watered because roots have not had time to grow to the depths of available moisture. A field windbreak designed and managed for uniform snow distribution should provide good overall protection and result in healthier crops, if not increased yields.

Designing New Field Windbreaks to Prepare for Future Droughts

Field windbreaks can be designed to adequately maximize beneficial functions to agricultural crops. Designing an individual windbreak to perform these functions, which have tempering effects in drought, requires proper orientation (usually east-west or north-south), proper choice of species, proper spacing, and for some species, pruning the lower crown. For specific information on orientation, species selection, spacing, pruning, and managing field windbreaks, contact your local County Extension Office and ask for CD-FO-0824, *Field Windbreaks*, published in 1981.

If the drought lesson that nature has tried to teach us has been learned, we can do something now to prepare for the next cycle of drought and dust storms, sure to come. We can plan to put into practice appropriate soil and water conservation measures which include planting field windbreaks. Also, we should consider planting a network of both east-west and north-south field windbreaks, especially on large fields, to prepare for winds from four directions. Such a network would have maximum effect on controlling soil erosion, reducing evaporation and transpiration, reducing wind damage to crop leaves, and intercepting and holding snow on the cropland. This would take some land out of production and might be inconvenient on some farms using today's large equipment. However, sacrificing a little land and a little convenience would be far better than sacrificing an entire crop every time a cycle of drought and blowing topsoil like that of 1988 hits. We have the means and know-how to lessen the effects of future droughts. If we do not use this to advantage, we have no one to blame but ourselves when the next drought occurs. Mother Nature is better tempered than blamed. And in tempering Mother Nature, consider planting a shelterbelt on your farmstead to protect it from blowing dust—the farm family and livestock also suffer from extreme droughts and blowing winds. Contact your local County Extension Office and ask for CD-BU-0468, *Farmstead Shelterbelts—Protection Against Wind and Snow*, revised in 1988.